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HOLIDAY LAKE, LA SALLE COUNTY, ILLINOIS

Pacific Northwest Environmental Research Laboratory

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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NATIONAL EUTROPHICATION SURVEY

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REPORT

ON

HOLIDAY LAKE

LASALLE COUNTY

ILLINOIS

EPA REGION V

WORKING PAPER NO. 307

WITH THE COOPERATION OF THE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

AND THE

ILLINOIS NATIONAL GUARD

JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Illinois Environmental Protection Agency for professional involvement and to the Illinois National Guard for conducting the tributary sampling phase of the Survey.

Dr. Richard H. Briceland, Director of the Illinois Environmental Protection Agency; and Ronald M. Barganz, State Survey Coordinator, and John J. Forneris, Manager of Region III, Field Operations Section of the Division of Water Pollution Control, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

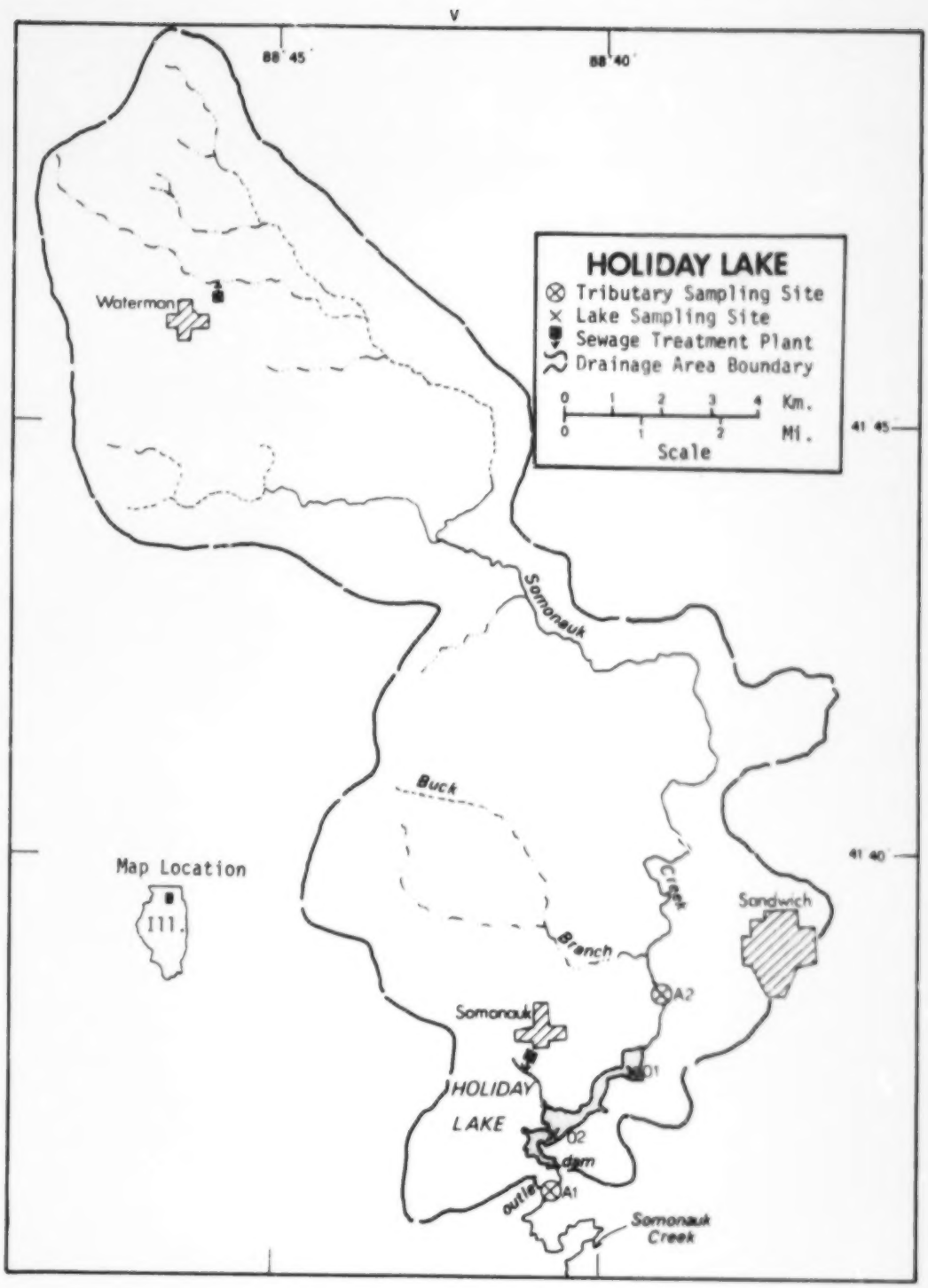
Major General Harold R. Patton, the Adjutant General of Illinois, and Project Officer Colonel Daniel L. Fane, who directed the volunteer efforts of the Illinois National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF ILLINOIS

LAKE NAME	COUNTY
Baldwin	Randolph
Bloomington	McLean
Carlyle	Bond, Clinton, Fayette
Cedar	Lake
Charleston	Coles
Coffeen	Montgomery
Crab Orchard	Jackson, Williamson
Decatur	Macon
DePue	Bureau
East Loon	Lake
Fox	Lake
Grass	Lake
Highland Silver	Madison
Holiday	LaSalle
Horseshoe	Madison
Long	Lake
Lou Yaeger	Montgomery
Marie	Lake
Old Ben Mine	Franklin
Pistakee	Lake, McHenry
Raccoon	Marion
Rend	Franklin, Jefferson
Sangchris	Christian
Shelbyville	Moultrie, Shelby
Slocum	Lake
Springfield	Sangamon
Storey	Knox
Vandalia	Fayette
Vermilion	Vermilion
Wee Ma Tuk	Fulton
Wonder	McHenry


V
88°45'
88°40'
41°45'
41°40'
HOLIDAY LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Plant
Drainage Area Boundary
0 1 2 3 4 Km.
0 1 2 Mi.
Scale
Waterman
Somonauk
Buck
Creek
Branch
Sandwich
Somonauk
HOLIDAY
LAKE
dam
outlet
A1
A2
01
02
Somonauk
Creek
Map Location
Ill.

HOLIDAY LAKE

STORET NO. 1754

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Holiday Lake is eutrophic. It ranked 19th in overall trophic quality when the 31 Illinois lakes sampled in 1973 were compared using a combination of six parameters*. Twenty of the lakes had less median total phosphorus, 15 had less median dissolved phosphorus, 23 had less median inorganic nitrogen, 22 had less mean chlorophyll a, and 22 had greater mean Secchi disc transparency.

Survey limnologists reported a blue-green algal bloom in progress in August, 1973.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Holiday Lake was phosphorus limited at the time the sample was collected (05/09/73). The lake data indicate phosphorus limitation in August as well but nitrogen limitation in October.

C. Nutrient Controllability:

1. Point sources--The only known point sources impacting Holiday Lake were the towns of Waterman, which contributed 23.3% of the total phosphorus load, and Somonauk which contributed

* See Appendix A.

25.1%. Information on nutrient loads from shoreline septic tanks is lacking, but the Survey limnologists noted that the shoreline is well developed, and the lake is assumed to be under much seasonal recreational pressure. Nutrient loads from these sources probably contributed to the poor water quality observed at Holiday Lake.

The present phosphorus loading rate of 4.03 $g/m^2/yr$ is over four times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading rate (see page 12). Complete removal of phosphorus at the two point sources above would reduce the loading to 2.08 g $P/m^2/yr$. This would still be above the eutrophic loading rate but probably would result in persistent phosphorus limitation and a reduction in the incidence and severity of nuisance algal blooms in Holiday Lake.

2. Non-point sources--Somonauk Creek contributed nearly 45% of the total phosphorus load reaching Holiday Lake during the sampling year. The ungaged drainage areas were estimated to have contributed 6.4% of the total.

The phosphorus export rate of Somonauk Creek was estimated to be a rather low 15 kg P/km^2 (see page 12).

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 1.21 kilometers^2.
2. Mean depth: 2.7 meters.
3. Maximum depth: >4.0 meters.
4. Volume: 3.267×10^6 m^3.
5. Mean hydraulic retention time: 38 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Somonauk Creek	146.1	0.9
Minor tributaries & immediate drainage -	20.8	0.1
Totals	166.9	1.0

2. Outlet -

Somonauk Creek	168.1**	1.0

C. Precipitation***:

1. Year of sampling: 104.1 centimeters.
2. Mean annual: 86.5 centimeters.

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† Table of metric conversions--Appendix B.
†† Forneris, 1973.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Holiday Lake was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 0.9 meters at station 1 and 4.0 meters at station 2.

The results obtained are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE HOLIDAY
STORET CODE 1754

PARAMETER	1ST SAMPLING (5/ 9/73) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/ 7/73) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/16/73) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	14.9 - 15.0	14.9	14.9	25.6 - 28.1	26.9	26.7	16.1 - 17.4	17.0	17.4
DISS OXY (MG/L)	7.8 - 9.5	8.9	9.4	8.6 - 9.4	8.6	8.5	10.0 - 10.6	10.3	10.3
CNDCTVY (MCROMO)	590. - 615.	599.	595.	615. - 670.	639.	626.	472. - 473.	473.	473.
PH (STAND UNITS)	8.0 - 8.1	8.0	8.0	8.2 - 8.6	8.5	8.5	8.6 - 8.6	8.6	8.6
TOT ALK (MG/L)	160. - 200.	175.	170.	248. - 292.	266.	266.	208. - 224.	215.	214.
TOT P (MG/L)	0.166 - 0.205	0.177	0.168	0.091 - 0.324	0.187	0.114	0.152 - 0.212	0.173	0.154
ORTHO P (MG/L)	0.089 - 0.096	0.091	0.089	0.017 - 0.068	0.038	0.027	0.021 - 0.034	0.025	0.021
NO2+NO3 (MG/L)	8.870 -10.200	9.520	9.505	2.000 - 3.060	2.644	2.890	0.030 - 0.050	0.040	0.040
AMMONIA (MG/L)	0.140 - 0.150	0.142	0.140	0.090 - 0.270	0.168	0.160	0.030 - 0.040	0.033	0.030
KJEL N (MG/L)	0.900 - 1.100	1.000	1.000	1.400 - 3.700	2.220	1.900	1.000 - 1.400	1.233	1.300
INORG N (MG/L)	9.020 -10.348	9.662	9.645	2.190 - 3.190	2.812	3.110	0.060 - 0.090	0.073	0.070
TOTAL N (MG/L)	9.870 -11.300	10.528	10.455	4.390 - 5.950	4.864	4.600	1.030 - 1.450	1.273	1.340
CHLRPYL A (UG/L)	4.1 - 6.8	5.4	5.4	53.2 - 109.2	81.2	81.2	66.5 - 67.5	67.0	67.0
SECCHI (METERS)	0.2 - 0.2	0.2	0.2	0.2 - 0.8	0.5	0.5	0.3 - 0.6	0.4	0.4

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/09/73	1. Blue-green filaments	160
	2. Flagellates	160
	3. *Cryptomonas sp.*	114
	4. *Stephanodiscus sp.*	91
	5. *Navicula sp.*	68
	Other genera	318
	Total	911
08/07/73	1. *Aphanizomenon sp.*	9,415
	2. *Melosira sp.*	1,659
	3. *Coelastrum sp.*	1,076
	4. *Stephanodiscus sp.*	1,031
	5. *Phacus sp.*	224
	Other genera	1,077
	Total	14,482
10/16/73	1. *Cryptomonas sp.*	2,620
	2. *Stephanodiscus sp.*	891
	3. *Melosira sp.*	262
	4. *Schroederia sp.*	157
	5. *Euglena sp.*	131
	Other genera	891
	Total	4,952

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
05/09/73	01	4.1
	02	6.8
08/07/73	01	109.2
	02	53.2
10/16/73	01	66.5
	02	67.5

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.030	7.385	6.5
0.050 P	0.080	7.385	31.9
0.050 P + 1.0 N	0.080	8.385	34.9
1.0 N	0.030	8.385	6.2

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Holiday Lake was high at the time the assay sample was collected (05/09/73). There was a significant increase in yield when the level of orthophosphorus was increased, but there was no change in the yield compared to the control when only nitrogen was added. Based on these results, phosphorus limitation is indicated.

The lake data indicate phosphorus limitation in August also (the mean N/P ratio was 74/1) but nitrogen limitation in October (the mean N/P ratio was 3/1).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Illinois National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of February when two samples were collected. Sampling was begun in June, 1973, and was completed in May, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Illinois District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the adjusted nutrient loads, in $kg/km^2/year$, at station A-2 and multiplying by the ZZ area in km^2.

The communities of Waterman and Somonauk did not participate in the Survey, and nutrient loads were estimated at 1.134 kg P and 3.401 kg N/capita/year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal† -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)*	Receiving Water
Waterman	1,000	aer. pond	378.5	Little Indian Creek
Somonauk	1,080	act. sludge	408.8	Tomahawk Ditch

2. Known industrial - None

† Anonymous, 1972.
* Estimated at 0.3785 m^3/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Somonauk Creek	2,185	44.8
b. Minor tributaries & immediate drainage (non-point load) -	310	6.4
c. Known municipal STP's -		
Waterman	1,135	23.3
Somonauk	1,225	25.1
d. Septic tanks - Unknown	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	20	0.4
Total	4,875	100.0

2. Outputs -

Lake outlet - Somonauk Creek 3,185

3. Net annual P accumulation - 1,690 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Somonauk Creek	206,105	84.5
b. Minor tributaries & immediate drainage (non-point load) -	29,350	12.0
c. Known municipal STP's -		
Waterman	3,400	1.4
Somonauk	3,675	1.5
d. Septic tanks - Unknown	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	1,305	0.6
Total	243,835	100.0

2. Outputs -

Lake outlet - Somonauk Creek 212,665

3. Net annual N accumulation - 31,170 kg.

* See Working Paper No. 175.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Somonauk Creek	15	1,411

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m²/yr	4.03	1.40	201.5	25.8

Vollenweider loading rates for phosphorus (g/m²/yr) based on mean depth and mean hydraulic retention time of Holiday Lake:

"Dangerous" (eutrophic rate)	0.98
"Permissible" (oligotrophic rate)	0.49

V. LITERATURE REVIEWED

Anonymous, 1972. Wastewater treatment works data book. IL Env. Prot. Agency, Springfield.

Forneris, John J., 1973. Personal communication (lake morphometry). IL Env. Prot. Agency, Springfield.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN WARNINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1703	LAKE BLOOMINGTON	0.050	5.730	494.667	26.200	14.400	0.020
1706	LAKE CARLYLE	0.084	1.270	477.889	17.367	11.000	0.032
1708	LAKE CHARLESTON	0.160	4.680	490.667	12.000	8.400	0.065
1711	COFFEEN LAKE	0.032	0.260	456.222	7.700	14.900	0.012
1712	CRAB ORCHARD LAKE	0.082	0.200	482.222	59.867	13.000	0.013
1714	LAKE DECATUR	0.129	3.750	479.571	43.800	14.500	0.062
1725	LONG LAKE	0.784	1.190	482.667	49.333	8.000	0.398
1726	LAKE LOU YAEGER	0.146	1.600	489.583	10.662	11.400	0.076
1727	LAKE MARIE	0.098	0.370	487.667	39.533	14.700	0.057
1733	PISTAKEE LAKE	0.283	0.370	485.667	75.867	7.000	0.062
1735	REND LAKE	0.071	0.210	471.500	23.533	12.700	0.012
1739	LAKE SHELBYVILLE	0.062	3.290	461.333	17.161	14.800	0.019
1740	SILVER LAKE (HIGHLAND)	0.226	0.970	489.500	5.822	14.800	0.057
1742	LAKE SPRINGFIELD	0.108	3.265	483.385	13.013	10.800	0.059
1748	VERMILION LAKE	0.109	4.695	481.500	31.150	14.200	0.050
1750	WONDER LAKE	0.426	0.890	486.000	98.533	7.800	0.132
1751	LAKE STORY	0.072	2.510	459.333	17.250	14.000	0.021
1752	DEPUE LAKE	0.438	4.850	490.000	58.833	7.600	0.276
1753	LAKE SANGCHRIS	0.050	1.970	475.417	19.292	14.500	0.009
1754	LAKE HOLIDAY	0.167	3.135	485.167	51.217	7.200	0.046
1755	FOX LAKE	0.219	0.375	486.167	63.850	8.800	0.083
1756	GRASS LAKE	0.381	0.820	481.000	83.500	5.900	0.093
1757	EAST LOON LAKE	0.076	0.120	450.000	22.300	14.900	0.018
1758	SLOCUM LAKE	0.865	0.200	487.333	221.100	5.800	0.362
1759	CEDAR LAKE	0.029	0.170	400.333	5.767	12.800	0.013
1761	LAKE MENDOTA	0.069	1.770	466.333	7.967	14.500	0.031
1762	RACCOON LAKE	0.184	0.310	484.333	19.217	13.800	0.020
1763	BALDWIN LAKE	0.044	0.140	461.167	11.333	13.200	0.007

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
1764	LAKE VANDALIA	0.116	0.480	478.111	11.278	14.800	0.023
1765	OLD BEN MINE RESERVOIR	0.930	0.285	478.333	31.433	11.200	0.575
1766	HORSESHOE LAKE	0.127	0.705	482.833	182.250	6.400	0.010

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NU
1703	LAKE BLOOMINGTON	88 (26)	0 (0)	80 (24)	47 (14)	13 (2)	68 (20)	296
1706	LAKE CARLYLE	63 (19)	40 (12)	63 (19)	63 (19)	63 (19)	53 (16)	345
1708	LAKE CHARLESTON	37 (11)	7 (2)	0 (0)	77 (23)	77 (23)	27 (8)	225
1711	COFFEEN LAKE	97 (29)	77 (23)	93 (28)	[illegible] (28)	2 (0)	92 (27)	454
1712	CRAB ORCHARD LAKE	67 (20)	90 (27)	43 (13)	20 (6)	42 (12)	85 (25)	347
1714	LAKE DECATUR	40 (12)	13 (4)	53 (16)	33 (10)	30 (8)	32 (9)	201
1725	LONG LAKE	7 (2)	43 (13)	40 (12)	30 (9)	72 (21)	3 (1)	195
1726	LAKE LOU YAEGER	30 (9)	37 (11)	7 (2)	87 (26)	57 (17)	23 (7)	241
1727	LAKE MARIE	60 (18)	66 (20)	73 (22)	37 (11)	23 (7)	42 (12)	303
1733	PISTAKEE LAKE	27 (8)	66 (20)	23 (7)	13 (4)	90 (27)	32 (9)	253
1735	RENO LAKE	77 (23)	80 (24)	70 (21)	50 (15)	53 (16)	92 (27)	422
1739	LAKE SHELBYVILLE	83 (25)	17 (5)	83 (25)	70 (21)	13 (2)	73 (22)	339
1740	SILVER LAKE (HIGHLAND)	20 (6)	47 (14)	10 (3)	97 (29)	13 (2)	42 (12)	229
1742	LAKE SPRINGFIELD	53 (16)	20 (6)	33 (10)	73 (22)	67 (20)	37 (11)	283
1748	VERMILION LAKE	50 (15)	3 (1)	47 (14)	43 (13)	37 (11)	47 (14)	227
1750	WONDER LAKE	13 (4)	50 (15)	20 (6)	7 (2)	80 (24)	13 (4)	183
1751	LAKE STORY	73 (22)	27 (8)	90 (27)	67 (20)	13 (2)	63 (19)	333
1752	DEPUE LAKE	10 (3)	10 (3)	3 (1)	23 (7)	83 (25)	10 (3)	139
1753	LAKE SANGCHRIS	88 (26)	30 (9)	67 (20)	57 (17)	30 (8)	97 (29)	369
1754	LAKE HOLIDAY	33 (10)	23 (7)	27 (8)	27 (8)	87 (26)	50 (15)	247
1755	FOX LAKE	23 (7)	63 (19)	17 (5)	17 (5)	72 (21)	20 (6)	212
1756	GRASS LAKE	17 (5)	53 (16)	50 (15)	10 (3)	97 (29)	17 (5)	244
1757	EAST LOON LAKE	70 (21)	100 (30)	97 (29)	53 (16)	2 (0)	77 (23)	399
1758	SLOCUM LAKE	3 (1)	87 (26)	13 (4)	0 (0)	100 (30)	7 (2)	210
1759	CEDAR LAKE	100 (30)	93 (28)	100 (30)	100 (30)	50 (15)	85 (25)	526
1761	LAKE WENATUK	80 (24)	33 (10)	77 (23)	90 (27)	30 (8)	57 (17)	367
1762	RACCOON LAKE	57 (17)	73 (22)	30 (9)	60 (18)	42 (12)	68 (20)	330
1763	BALDWIN LAKE	93 (28)	97 (29)	87 (26)	80 (24)	47 (14)	100 (30)	504

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1764	LAKE VANDALIA	47 (14)	60 (18)	60 (18)	83 (25)	13 (2)	60 (18)	323
1765	OLD BEN MINE RESERVOIR	0 (0)	83 (25)	57 (17)	40 (12)	60 (18)	0 (0)	240
1766	HORSESHOE LAKE	43 (13)	57 (17)	37 (11)	3 (1)	93 (28)	80 (24)	313

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1759	CEDAR LAKE	528
2	1763	BALDWIN LAKE	504
3	1711	COFFEEN LAKE	454
4	1735	REND LAKE	422
5	1757	EAST LOON LAKE	399
6	1753	LAKE SANGCHRIS	369
7	1761	LAKE WEMATUK	367
8	1712	CRAB ORCHARD LAKE	347
9	1706	LAKE CARLYLE	345
10	1739	LAKE SHELBYVILLE	339
11	1751	LAKE STORY	333
12	1762	RACCOON LAKE	330
13	1764	LAKE VANDALIA	323
14	1766	HORSESHOE LAKE	313
15	1727	LAKE MARIE	303
16	1703	LAKE BLOOMINGTON	296
17	1742	LAKE SPRINGFIELD	283
18	1733	PISTAKEE LAKE	253
19	1754	LAKE HOLIDAY	247
20	1756	GRASS LAKE	244
21	1726	LAKE LOU YAEGER	241
22	1765	OLD BEN MINE RESERVOIR	240
23	1740	SILVER LAKE (HIGHLAND)	229
24	1748	VERMILION LAKE	227
25	1708	LAKE CHARLESTON	225
26	1755	FOX LAKE	212
27	1758	SLOCUM LAKE	210
28	1714	LAKE DECATUR	201

19.

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	1725	LONG LAKE	195
30	1750	WONDER LAKE	183
31	1752	DEPUE LAKE	139

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR ILLINOIS 10/23/75

LAKE CODE 1754 HOLIDAY LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 168.1

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1754A1	168.1	1.06	1.58	1.97	2.03	1.60	1.33	0.81	0.42	0.30	0.33	0.48	0.57	1.04
1754A2	146.1	0.92	1.37	1.70	1.76	1.38	1.15	0.70	0.36	0.26	0.28	0.41	0.49	0.89
1754ZZ	22.0	0.15	0.21	0.27	0.28	0.22	0.18	0.11	0.06	0.04	0.05	0.07	0.08	0.14

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 168.1
SUM OF SUB-DRAINAGE AREAS = 168.1

TOTAL FLOW IN = 12.50
TOTAL FLOW OUT = 12.50

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1754A1	6	73	1.87	2	3.11				
	7	73	0.20	7	0.22				
	8	73	0.12	4	0.15				
	9	73	0.05	9	0.04				
	10	73	0.76	13	1.78				
	11	73	0.14	7	0.15				
	12	73	0.68	1	0.16				
	1	74	3.28	6	0.85				
	2	74	3.00	2	3.28	16	1.56		
	3	74	2.58	6	5.04				
	4	74	2.18	6	2.61				
	5	74	5.52	4	1.53				
1754A2	6	73	1.61	2	2.69				
	7	73	0.18	7	0.19				
	8	73	0.10	4	0.12				
	9	73	0.04	9	0.03				
	10	73	0.65	13	1.53				
	11	73	0.12	7	0.13				
	12	73	0.59	1	0.13				
	1	74	2.80	6	0.74				
	2	74	2.61	2	2.83	16	1.36		
	3	74	2.24	6	4.36				
	4	74	1.87	6	2.24				
	5	74	4.76	4	1.33				
1754ZZ	6	73	0.25	2	0.42				
	7	73	0.03	7	0.03				
	8	73	0.02	4	0.02				
	9	73	0.01	9	0.00				
	10	73	0.11	13	0.25				
	11	73	0.02	7	0.02				
	12	73	0.48	1	0.11				
	1	74	0.48	6	0.11				
	2	74	0.40	2	0.45	16	0.20		
	3	74	0.34	6	0.68				
	4	74	0.31	6	0.37				
	5	74	0.76	4	0.20				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/10/23

175401
41 37 28.0 088 39 30.0
LAKE HOLIDAY
17099 ILLINOIS

11EPALES 2111202
3 0004 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/09	16 30	0000	15.0	9.5	6	600	8.00	160	0.140	1.100	10.200	0.096
73/08/07	17 00	0000	28.1		8	664	8.60	266	0.160	3.700	2.250	0.059
	17 00	0003	27.9	8.0		670	8.50	292	0.190	2.600	2.000	0.068
73/10/16	17 50	0000	16.1	10.6	12		8.60	224	0.030	1.000	0.030	0.034

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/09	16 30	0000	0.205	4.1
73/08/07	17 00	0000	0.310	109.2
	17 00	0003	0.324	
73/10/16	17 50	0000	0.212	66.5

STORET RETRIEVAL DATE 75/10/23

175402
41 36 35.0 088 40 40.0
LAKE HOLIDAY
17099 ILLINOIS

11EPALES
3

2111202
0017 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/09	16 45	0000	15.0		8	615	8.00	200	0.140	0.900	9.130	0.089
	16 45	0006	14.9	9.4		590	8.10	180	0.150	1.000	8.870	0.089
	16 45	0013	14.9	7.8		590	8.10	160	0.140	1.000	9.000	0.089
73/08/07	17 20	0000	26.7	9.4	32	615	8.60	248	0.090	1.900	3.020	0.017
	17 20	0005	26.1	9.0		620	8.50	266	0.130	1.400	3.060	0.020
	17 20	0010	25.6	8.0		626	8.20	258	0.270	1.500	2.890	0.027
73/10/16	18 00	0000	17.4		23	472	8.60	214	0.040	1.400	0.050	0.021
	18 00	0008	17.4	10.0		473	8.60	208	0.030	1.300	0.040	0.021

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/09	16 45	0000	0.168	6.8
	16 45	0006	0.168	
	16 45	0013	0.166	
73/08/07	17 20	0000	0.095	53.2
	17 20	0005	0.091	
	17 20	0010	0.114	
73/10/16	18 00	0000	0.154	67.5
	18 00	0008	0.152	

1

26.

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 75/10/23

1754A1
41 36 10.0 088 40 40.0
SUMUNAUK CREEK
17021 15 SANDWICH
O/HOLIDAY LAKE
RD BRDG BELO DAM 4 MI N O SHERIDAN
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/02	15 35		8.300	0.280	0.069	0.063	0.125
73/07/07	10 00		6.800	0.420	0.060	0.022	0.030
73/08/04	13 50		3.800	0.650	0.252	0.048	0.061
73/09/09	08 45		0.650	3.800	0.220	0.014	0.090
73/10/13	17 30		0.090	1.320	0.120	0.025	0.090
73/11/07			0.100	0.750	0.096	0.024	0.090
73/12/01	11 00		0.068	0.700	0.032	0.020	
74/01/06	14 30		1.680	1.100	0.060	0.020	0.060
74/02/02			10.500	1.000	0.125	0.115	0.195
74/02/16	12 30		9.900	0.800	0.115	0.090	0.140
74/03/06			8.600	1.000	0.045	0.060	0.168
74/04/06			9.800	0.700	0.020	0.035	0.055
74/05/04	13 30		6.800	1.700	0.170	0.020	0.120

STORET RETRIEVAL DATE 75/10/23

1754A2
41 38 20.0 088 39 10.0
SOMONAUK CREEK
17 15 SANDWICH
I/HOLIDAY LAKE
ST HWY 34 BRDG BETWEEN SOMONAUK&SANDWICH
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/02	15 00		11.200	0.290	0.011	0.048	0.105
73/07/07	10 00		7.800	0.100K	0.040	0.060	0.105
73/08/04	13 00		3.400	0.540	0.160	0.077	0.095
73/09/09	08 30		0.480	1.980	0.078	0.046	0.130
73/10/13	12 30		0.198	1.600	0.200	0.035	0.170
73/11/07	11 00		0.730	0.600	0.054	0.028	0.055
73/12/01	09 50		1.010	0.700	0.024	0.024	
74/01/06	15 00		6.500	1.000	0.032	0.016	0.060
74/02/02			9.900	0.800	0.110	0.115	0.200
74/02/16	13 00		8.900	0.500	0.040	0.040	0.075
74/03/06			11.800	0.900	0.025	0.050	0.155
74/04/06			9.900	0.900	0.025	0.035	0.060
74/05/04	13 55		8.900	2.200	0.280	0.085	0.270

K VALUE KNOWN TO BE
LESS THAN INDICATED